DOCUMENT RESUME

ED 089 878 PS 007 267

AUTHOR	Patterson, Joseph
TITLE	A Test for Artifacts in the "Conservation of Quantity" Section of the Intellectual Tasks Test. Research Report.
INSTITUTION	Arizona Univ., Tucson. Arizona Center for Early Childhood Education.
SPONS AGENCY	National Center for Educational Research and Development (DHEW/OE), Washington, D.C. Div. of Educational Labs.
PUB DATE	Apr 70
CONTRACT	OEC-3-7-70706-3118
NOTE	6p.
EDRS PRICE	MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS	Cognitive Development; Concept Formation; *Conservation (Concept); *Disadvantaged Youth; Educational Diagnosis; *Elementary School Students; *Motivation; Negroes; Reinforcement; *Research Problems; Testing Problems; Tests
IDENTIFIERS	Counting; *Intellectual Tasks

ABSTRACT

Two studies attempted to clarify the Intellectual Tasks test assessment of number conservation by testing for two possible artifacts due to procedure: (1) Effects of preceding questions on the following test questions, and (2) operations or manipulations of the test materials by the examiner. Forty Mexican-American first and second graders were divided into four experimental groups, receiving (1) the original test procedure, (2) control for order (asking final test questions first) but not manipulation, (3) control for manipulation (different sets of objects, glued down) but not order, and (4) controls for both possible artifacts. It was predicted that the control procedures would lead to a greater number of conservers, particularly on Test 1 (7 items) as opposed to Test 2 (15 items). Results were unclear, but did not support the predictions. Two research problems were identified: (1) Subjects' motivation and (2) their ability to count. A second study tested 24 Mexican-American and Black first and second graders from a classroom operating on a token-economy basis. A significantly higher percentage of these children could count and conserve on the 15-item task. Discussion focuses on the importance of motivational variables in human learning research with disadvantaged children. (DP)

ED 089878

Document Number 70706-A-F0-R-31
Printed April, 1970

U.S. DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

A Test for Artifacts in the "Conservation of Quantity" Section of the Intellectual Tasks Test

Joseph Patterson

University of Arizona

Research Report

PS 002267

The research or work reported herein was performed pursuant to a contract with the Office of Education, U. S. Department of Health, Education, and Welfare through the Arizona Center for Early Childhood Education, a component of the National Laboratory on Early Childhood Education, contract OEC-3-7-70706-3118.

Contractors undertaking such work under Government sponsorship are encouraged to express freely their professional judgment in the conduct of work. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

A TEST FOR ARTIFACTS IN THE "CONSERVATION OF QUANTITY" SECTION OF THE INTELLECTUAL TASKS TEST

Joseph Patterson, University of Arizona

Jean Piget's developmental theory has several educational applications. One application is for description of children's thought modes to be used on curricula planning. First the findings of tests based on the developmental rationale could be used to determine grade placement of instructional content, and second, use of the developmental sequences to anticipate and guard against subtle, nonobvious "misacquisitions" which the child is likely to fall prey to in the learning process. Once the curriculum is planned, the findings aid in actual teaching with attention to the ways that children develop their thoughts (Flavell, 1963).

Most of the standardization projects in the application of Piaget's developmental theory seem to support his primary findings. Several studies are cited in John Flavell's summary of the theories of Piaget (Flavell, 1963). Vinh-Bang and Barbel Inhelder at the Institut des Sciences de l'Education of the University of Geneva (Vinh-Bang, 1957, 1959) and Father Adrien Pinard at the University of Montreal have done the largest studies of this kind. Many studies (Smedslund, 1960) have shown that the development of the stages of concept formation are very hard to reproduce in the laboratory and that the concepts themselves are very difficult to teach to a child through operant techniques. Flavell (1963) also cites many researchers which have attempted to validate Piaget's findings on number and quantity.

Dr. Marie Hughes at the University of Arizona has developed a test, the INTELLECTUAL TASKS, which follows the rationale of Piaget's developmental theory. At present, the test is being administered as a descriptive instrument in the analysis of the first grade Mexican-American children in the Tucson public schools.

According to Piaget, there is a certain age dependent development of the concept of number. "Conservation of Number" is a type of the general category of "Conservation of Quantity." It is the ability of the child to conceptualize a quality of an object or class of objects as being unchangeable by division, change of shape, or other manipulations of its material which change its general configuration or Gestalt. "Number" is discontinuous quantity which remains the same regardless of how its constituant parts are arranged or how the items differ from one another. Piaget's writings point to the inability of small children to conserve number. According to Piaget, children do not begin to conserve number until about seven years of age. He says that this ability does not emerge suddenly, but the child passes through a transition stage during which he can conserve smaller number, but not larger ones, and during which simple configurations can be conserved, but not more complex configurations of items. During this transition stage, the child may be unable to conserve number in many situations and yet be capable of counting to much higher numbers than he is asked to deal with in the test situation. Conservation of number is not just rote memorization of a certain number sequence nor does

non-conservation mean that the child can not count the items. This concept development is not a function of maturation alone but is dependent upon experience, learning, and other factors such as stimulus familiarity. One reason for the present testing by the Early Childhood Research and Development Center is the belief that the Mexican-American child in the first or second grade has not had the experiences which are necessary for development of these concept which are of vital importance to his being able to progress in education. The Hughes group believes that the impoverished child will be lagging in his development of the concepts which the INTELLECTUAL TASKS test purports to measure.

This experiment attempted to test for two possible artifacts due to procedure in the testing with the INTELLECTUAL TASKS. First, the effects of preceding questions on the following test questions, and second, the operations or manipulations of the test materials by the tester were studied in the "Conservation of Quantity" section of the INTELLECTUAL TASKS. By order of presentation, we refer to the effect of having the A and B questions come before the C question which actually tests the child's ability to conserve number. For example, in test I, the child has been asked twice if the number of dominoes in two groups of seven are the same before he gets to part C. It was felt that the child might still know that there were the same number of dominoes in each group but attempt to get the "right" answer by changing the previous answers of "same" to

"different." By operations, we refer to the effect of rearranging the dominoes in the presence of the child, making a point that he is paying attention, while not changing the actual numbers involved and asking him three times if there are that same number of dominoes in each of the two groups. The question we asked whether the child actually does not conserve number when he answers "different" for the C question, or does he believe that by rearranging the objects, the tester is trying to get him to change his first answers.

We predicted that by presenting the C questions first without previous order of questioning or operations on the test materials by the tester there would be a greater number of children show conservation. Also, we predicted that more subjects would conserve for test 1 which involved seven items than on test 2 which involved fifteen items.

METHOD

Subjects

Forty Mexican-American first and second grade children from the Menlo Park elementary school were selected unsystematically from three experimental classrooms. Twenty-three of the subjects were from first grade classrooms as no attempt was made to balance the numbers from each grade. Most of the children were from impoverished families and surroundings, but we had no socio-economic rating for each subject.

Apparatus

One room of a three room trailer was used for all parts of the experiment. The room measures 8' by 10' and has a one-way mirror for observation from an adjoining room. One tester was in the room with one subject at a time for all parts of the testing.

Procedure

The forty subjects were divided unsystematically into four treatment groups of ten each. None of these subjects had been tested previously with the INTELLECTUAL TASKS tests. The procedure for those groups which required the tester to operate or manipulate the dominoes was run exactly as is done by the testers using the INTELLECTUAL TASKS, that is, the dominoes were gotten out of a box and arranged on a table before the subject. After each question, the dominoes were arranged in the configuration for the next question, while keeping the child's attention on the dominoes. Those groups tested while controlling for operations were shown each domino arrangement on separate poster boards with the dominoes glued down. In order to control for the order effect, question C of test 1 was given first followed by the A and B questions and question C of test 2 was given before the A and B questions.

PS 006260

The Order plus operations group (Group 1) was tested with exactly the same procedure as is used in the INTELLECTUAL TASKS. For test 1, question A, 14 dominoes are arranged face down in two, closed, parallel rows with each domino in a row corresponding exactly with each

domino in the other row (one to one correspondence). The subject was asked, "Are there the same number of dominoes in each of these two groups?" If the answer was "No," the subject was asked, "Which group has the most dominoes?" Question B of test 1 was the same as for A, but the domino arrangement was altered so that there were two, parallel, but not closed rows of dominoes with one to one correspondence. Question C of test 1 was the same as for A and B but the dominoes were arranged with the rows farther apart and with one row closed while the row [illegible]est the tester was left open as in B. The one to one correspondence between each domino in the two rows was missing in this arrangement. For test 2 a total of 30 dominoes was used with 15 in each group. Question A of test 2 concerned two closed, 3" by 5" rectangles of 15 dominoes each. The subject was asked, "Are there the same number of dominoes in each of these two groups?" If the answer was "I don't know," he was asked, "How would you find out?" in an attempt to get some response. For question B one of the groups of dominoes was scattered within 8" by 10" limits and the subject was told, "Now look at these two groups of dominoes. Are there the same number of dominoes in these two groups?" If the answer was "No," he was asked, "Which group has the most dominoes?" Question C was the same as B, but the scattered group of dominoes was scattered more to within 16" by 20" limits while the other group remained closed as in A and B.

The No Order, No Operations group (Group II) had both order and operations effects controlled. Subjects received no preceding questions and the dominoes were not manipulated by the tester. The C questions of tests 1 and 2 were given without previous order of test questions and with questions A and B following. The domino arrangements were the same as in Group I, but were presented in fixed arrangements on separate pieces of poster board.

Group III of the Order, No operations group had the operations effects controlled and received the order effects alone. Subjects received the questions in A, B, and C order on tests 1 and 2, but operations were eliminated by using the set arrangements.

Group IV received the operations effects with the order effect controlled by receiving the C question first in both tests followed by questions A and B. The dominoes were manipulated by the tester before the subjects.

RESULTS AND DISCUSSION

In the analysis of the data, only the responses given to the C parts of tests 1 and 2 were considered in that those two questions were the only ones which tested conservation of number. An answer of "same" or conservation by the subjects was given a score of 1, while "not same" meaning non-conservation was given a zero. As can be seen from Figure 1,

more subjects conserved on test 2 than on test 1 except for the Order plus Operations group (Group I), contrary to our predictions. No significant differences were found between the two tests when a 't' test was run. The analysis of variance of the summed test scores proved the operations effects to be significant at the five percent level and the interaction effects of operations and order to be significant at the one percent level. When 't' tests were run to determine the significance of operations along between the No Order, No Operations group (Group II) and the Operations, No Order (Group IV) for test 1 and test 2, no significant differences were found.

From these results and inspection of Figure 1, it can be seen that our prediction of the interaction of order and operations was upheld but with somewhat different implications than in the original prediction. The elevation of test 1 which used seven dominoes and the depression of test 2 which used 15 dominoes might be explained in terms of Piaget's explanation of the development of the conservation of number during the transition stage. The simpler configuration with seven dominoes might have been conserved by the child when aided by the order and operations in the test while such effects would be detrimental to conservation on the test 2 which used a greater number of items in a more complex configuration. Complexity has been shown to lead to random responses in some previous studies, and in this study may have led the child to change his

answers on the C question. More testing will be necessary to make a differentiation between test 1 and test 2.

Our prediction of the depressing effects of order and operations as well as their interactions was not confirmed.

While running the experiment several observations were made which might lead to further investigation and insight into the problems encountered in this study. Through inspection of the data there was no apparent differences between the numbers of first and second grade children who were able to conserve number on this test. Piaget's writings would lead us to believe that there should be significant differences between first and second graders. Thirty of the subjects were asked to count the dominoes in the closed and scattered groups of 15 dominoes. Only six of these were able to count both groups of 15 correctly even when urged to use all available means such as hands and fingers. Of the 12 subjects who attempted to count with their fingers, only five counted both groups correctly. These findings would lead us to hypothesize that some of these children are at an even more immature stage of development in the Piaget theoretical framework than the transition stage where the child can count but not conserve number. This counting ability was tested in the second experiment which is reported later.

Other problems which seemed to affect the results were motivational and language and possibly some difficulty due to familiarity with the

testing materials. We were unable to test two subjects because they would not respond in any manner. Several cases indicated low motivation toward correct answers in that no attempts were made to double-check the answers the child had arrived at by counting. Two subjects appeared to believe that the experimenter was asking them to guess at the number of dots on the down-turned faces of the dominoes even after much explanation by the experimenter.

COUNTING ABILITY

Two major problems seemed to be very important in the results that were obtained in the first test; first, there was motivation and second, the perceptual-motor skill or ability to count items correctly. The child must be motivated to make an attempt to get a correct answer and in order for that attempt to be successful he must have the ability to perform the task. As mentioned previously, many of the subjects appeared to make random responses and no subjects were observed "double-checking" the responses given.

Motivation for obtaining the correct response should improve in situations where the child has been consistently reinforced for correct responses. Such motivation should also lead toward more attention by the child to the problem situation and the available cues as well as double-checking the solution to the problem.

Ability to count involves structuring the configuration of items to be counted so that all items are counted once and no items are duplicated. It was my hypothesis that children enrolled in a classroom with an emphasis on structured activities would be better able to count than children from a less structured classroom. Also I predicted that children from a classroom with an emphasis on reward being contingent upon correct responses to problem situations would be more motivated in their counting activities.

METHOD

Subjects

The subjects were 24 Mexican-American and Negro children from Davis Elementary School. There were eight first grade children and 16 second graders enrolled in Mrs. Lowe's experimental classroom. Mrs. Lowe uses a token system of operant reinforcement for desired behavior with an emphasis on motivation and structured activities. The socio-economic status of the children is comparable to the children from the Menlo Park experimental classrooms.

Apparatus

An empty classroom next to Mrs. Lowe's classroom was used for all subjects. Testing materials were dominoes which were arranged face down on a table before the subject or dominoes which were glued face down on pieces of poster board in a set arrangement.

Procedure

Each child was asked the C question of test 1 first followed by the C question of test 2 of the "Conservation of Quantity" section of the INTELLECTUAL TASKS test. Thirteen of the subjects had the dominoes arranged by the tester before them as is the procedure in testing with the INTELLECTUAL TASKS. Eleven of the subjects were shown the domino arrangement on the pieces of poster board. After the child had answered either "yes" or "no" as to whether the two groups were the same in number, he was asked to count the two groups of 15 dominoes in the C question of test 2. The child was urged to use all available means of obtaining the correct answer and was prompted in all cases to use his fingers.

RESULTS

Fourteen of the children from the Davis classroom of 24 children successfully counted both groups of 15 dominoes as compared to six from a sample of 30 from the Menlo Park classrooms. This was significant past the one percent level when a 't' test was run.

The differences between the number of children showing conservation of quantity as judged by the answers to the C questions between the Davis school sample and the Menlo Park sample were significant at the one percent level for the groups of 15 dominoes, but not for the groups of seven dominoes.

In the Davis sample, there was no significant difference in the number of children who successfully counted the groups of 15 dominoes when the dominoes were arranged on the table or were on the poster board.

There were seven children in the Davis group who showed very pronounced signs of rechecking their answers and in some cases corrected their first incorrect response. As mentioned earlier, there were no children at Menlo Park who were observed double-checking responses.

DISCUSSION

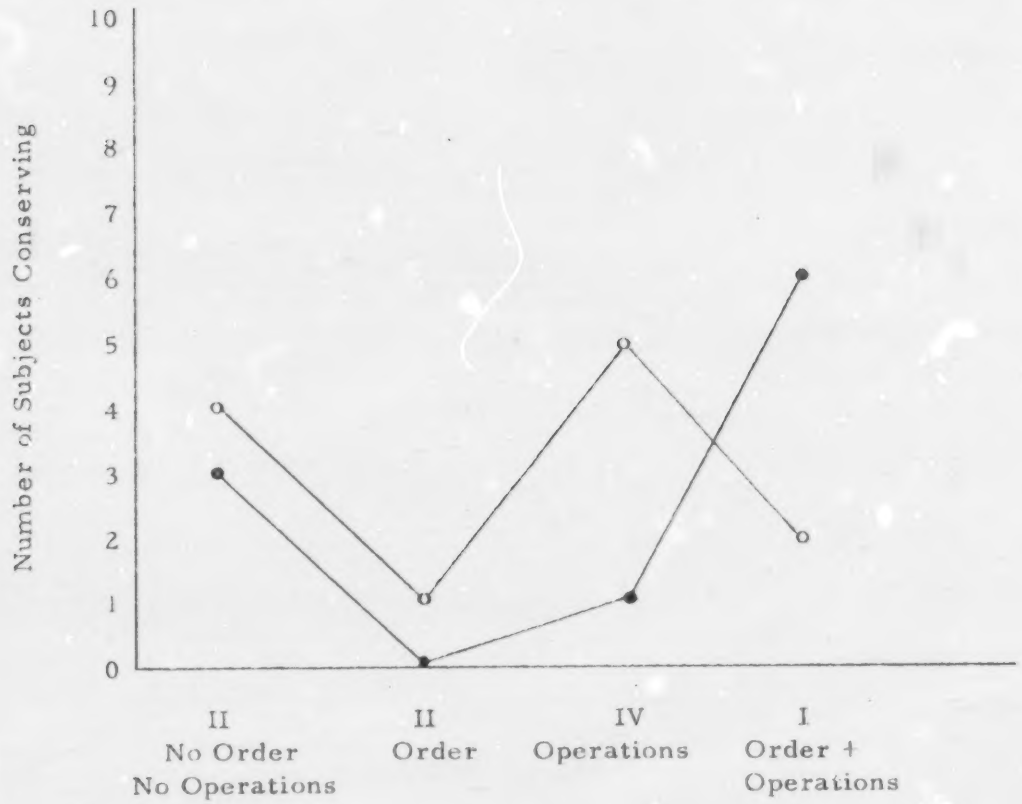
Motivation is a serious problem in all human learning research and is an especially difficult problem when working with underprivileged children. Motivation has some especially subtle factors in such tests as the INTELLECTUAL TASKS and the experiments which I have conducted. The child may be motivated enough to respond to the questions and in many cases will emit a large number of responses. When all responses on the part of the child are accepted and even promoted as is often the case when trying to increase the rate of responding in a classroom situation, the value of a "correct" response may lose some of its value. The child may learn to come up with an answer to a question with little attention to its correctness. The correctness of a response must have relevance to the child. Striving for correct responses is indicated by

a more careful approach to the problem by the child and by double-checking answers. Motivation for correct responses also causes a child to use all tools available in order to arrive at the correct solution. These tools would be concepts such as conservation of quantity and skill at counting.

According to Piaget, conservation of quantity is a concept that is not necessarily dependent upon rote memorization of a number series such as verbal counting. Conservation of quantity does depend upon the perceptual-motor skill or ability to count items because the definition of conservation is number constancy regardless of item configuration or Gestalt. When a child attempts to count two groups of items in order to find out whether there are the same number in each group, he is showing that he has learned the concept of conservation. If the child has not developed the perceptual-motor skill to successfully use that concept, it is useless to him.

Undoubtedly there are many children in the samples used in the two experiments that I have reported who are ruled by global qualities of the configurations of dominoes and who do not conserve number. On the other hand, there are several who have been taught the concept of number conservation as shown by their attempts at counting, but who have not been given the skill which is necessary to utilize the concept.

Figure 1


Number of Subjects Conserving
10
9
8
7
6
5
4
3
2
1
0
II
No Order
No Operations
II
Order
IV
Operations
I
Order +
Operations
TREATMENT GROUPS
• test 1--7 dominoes
o test 2--15 dominoes